

Applicant: Cuong Nguyen, et al.
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Application No. 10/707,496

Amendments to the Specification:

Please replace paragraph 0003 with the following amended paragraph:

[0003] Consumers of electricity can benefit from having a power generating system which uses multiple power sources. For instance, using multiple power sources provides a measure of redundancy in case one or more of the power sources becomes temporarily unavailable (i.e. "brownouts" and "blackouts" which are prevalent in many parts of the world). Besides providing redundancy, consumers may recognize a cost savings when using generators to augment or replace the power grid. Using multiple smaller generators allow the optimization of efficiency and/or system reliability based on the power demand at the site. Accordingly, power generating systems are increasingly using multiple power sources to provide power for consumers' ~~consumer's~~ loads.

Please replace paragraphs 0013-0016 with the following amended paragraphs:

[0013] Another aspect of the present invention provides a method of supplying power to a load using a plurality of generators, which includes the steps of connecting the plurality of generators to the load; providing a synch frequency from a controller which is not a component of a generator; and providing power from each of the plurality of generators to the load wherein the power provided by each of the generators comprises a frequency which is substantially the synch frequency.

[0014] Another aspect of the present invention provides a power generating system, which includes a generator including an inverter capable of producing an output waveform having a frequency to power a load; and a controller connected to the generator wherein the controller is capable of providing the frequency for producing the output waveform and is operative to drift the frequency to substantially match a frequency from a second power source.

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[0015] Another aspect of the present invention provides a power distribution system, which includes a load; a grid power source connected to the load which provides power having a grid frequency; a generator connected to the load which provides power having a generator frequency; a controller connected to the generator wherein the controller is operative to provide the generator frequency to the generator and is operative to drift the generator frequency to the grid frequency; and a sensor connected to the grid power source and to the controller that measures a grid operating condition.

[0016] Another aspect of the present invention provides a method for detecting whether a potential power source is still providing power to a load, which includes the steps of providing power having a first frequency from a first power source to the load; providing power having a second frequency from a second power source to the load wherein the second frequency is substantially the same as the first frequency; attempting to drift the second frequency of the power from the second power source away from the first frequency of the power from the first power source; monitoring the second frequency of the power provided by the second power source; and evaluating whether the first power source is providing power to the load.

Please replace paragraphs 0034-0035 with the following amended paragraphs:

[0034] A next step in accordance with one embodiment of the present invention, is having a second power source supply power at a value of the parameter to the load such that the value of the parameter is substantially the same as the value of the parameter of the power produced by the first power source when the first power source is supplying power to the load as shown in Block 120. The second power source may obtain the value of the parameter of the power from the first power source from the monitoring of the first power source. If the first power source is no longer supplying power to the load then the second power source may supply power to the load at a fundamental value that can be generated independently by the second power source. For instance, the second power source could supply power having a frequency of substantially 50 or

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60 Hertz using a default frequency generator that may be included within or connected to the generator. In other embodiments of the present invention, the second power source can supply power to the load using a value that was previously monitored from the power produced by the first power source. This previously monitored value may include the last monitored value that was within the range of values for the parameter. This monitored value may be stored in a memory device. In still other embodiments of the present invention, the value of the parameters of the power from the second power source is drifted from its value when the first power source is disconnected to from a default frequency.

[0035] If the first power source is not within a certain range of the desired value for the parameter, the first power source is disconnected from the load as shown in Block 130. The power from the first power source is monitored as before and if and when the value of the parameter of the power is within the range, the first power source is reconnected to the load while the second power source continues to provide power to the load as shown in Block 140. In some embodiments of the present invention, the value of the parameter of the second power source is first drifted towards the value from the first power source until it is substantially the same as the value of the parameter for the first power source and then the first power source is reconnected to the load. Typically, values are substantially the same when a ~~deviation~~'s deviation's effect, if any, on the system is acceptable to the user, manufacturer, or other third party.

Please replace paragraphs 0039-0040 with the following amended paragraphs:

[0039] In other embodiments of the present invention, the range of values may be provided by the manufacturer of the generator, the user of the generator, or any interested third party. Providing this range may be accomplished by providing a low limit value and a high limit value which ~~corresponds~~ correspond to the ends of the range. These values may be stored within an electrical controller, within the generator, or within some other memory device which is well

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known to one of ordinary skill in the art.

[0040] The width of the frequency range may be specified by the ~~generator's~~ generator's manufacturer, the user powering the load, or any other interested third party. Generally, the width of the frequency range may depend on the sensitivity of the load to deviations from the frequency for which the generator is designed to provide power. As above, typically power may be provided having a frequency of sixty Hertz which is common in North America or fifty Hertz which is common in Europe and other parts of the world. Typically, the frequency range for a load is 3% around a desired frequency and voltage range is 10% around a desired voltage. Again, a frequency which is substantially 60 Hertz for each of the generators is a prevalent ~~designed for~~ frequency in many areas of North America including the United States. A prevalent ~~designed for~~ frequency ~~that each generator~~ for other areas of the world may be 50 Hertz.

Please replace paragraphs 0045-0050 with the following amended paragraphs:

[0045] Referring now to FIG. 3, a power generating system 300 in accordance with one embodiment of the present invention is illustrated. This power generating system 300 includes a plurality of generators 310a-n. Each generator 310a-n ~~310a~~ includes an inverter 320a-n ~~320a~~ which is capable of producing an output waveform having a frequency to power a load. This power generating system 300 further includes a controller 330 external to the generators wherein the controller 330 is connected to each of the plurality of generators 310a-n and wherein the controller 330 provides to each generator 310a-n the frequency for producing the output waveform and is operative to drift this frequency.

[0046] Referring now to FIG. 4, a power distribution system 400 in accordance with one embodiment of the present invention is illustrated. This power distribution system 400 includes a load 410 which is connected to a grid power source 420 and a generator 430. The grid power source 420 is operative to provide power having a frequency to the load 410. The power provided

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by the generator 430 to the load 410 also has a frequency. This illustrative system 400 also includes a controller 440 which is connected to the generator 430. The controller 440 is operative to provide the frequency to the generator 430. The generator 430 uses the frequency to produce power having that frequency. The controller 440 also is operative to disconnect the grid power source 420 from the load 410 if the frequency of the power provided by the grid power source 420 is not within a range of values. The controller 440 is further operative to drift the frequency used by the generator 430 in providing power to the frequency of the power provided by the grid power source 420. The illustrative system 400 also includes sensors ~~a sensor~~ 450 which is connected to the grid power source 420 and to the controller 440 that measures a grid operating condition. The ~~sensor~~ sensors 450 may take many forms as is well known in the art including a potential transformer that measures the parameters and relays the waveform at a lower voltage to the controller 440. These grid operating conditions may include the frequency, voltage, and phase of the power provided by the grid power source 420. In some embodiments of the present invention, the controller 440 is also operative to disconnect the grid power source 420 from the load 410 if the voltage of the grid power source 420 is outside the range of values.

[0047] In some embodiments of the present invention the controller 440 also includes a mode switch logic device 460 that is operative to disconnect and reconnect a power source. The mode switch logic device may be implemented using discrete solid state components or may be implemented using software executed on a processor or some combination thereof. The mode switch logic device 460 contains the digital logic to interpret the signals from sensors and compare them to ~~it~~ the parameter range to evaluate whether the power source is out of range and should be disconnected. The mode switch logic device 460 also may contain the logic to evaluate whether a disconnected power source is again in the acceptable parameter range and should be reconnected.

[0048] In some embodiments of the present invention the controller 440 includes a frequency range detector 470 which determines if the frequency of the power of a power source is within

the frequency range. The frequency range detector 470 may be implemented as discrete solid state components or may be implemented using software executed on a processor or some combination thereof. The frequency range detector 470 may contain logic to evaluate whether the value of the parameter measured by the sensor 450 is within or not within a given frequency range. The frequency range detector 470 can reference the frequency range values which are stored in the grid sync ~~controller~~controller. In some embodiments of the present invention the controller 440 also includes a frequency adjust loop 480 which operates to allow the frequency of a second power source to adjust to the frequency of the power from the first power source. The frequency adjust loop 480 may be implemented using a combination of hardware and software In some embodiments of the present invention, the controller 440 further includes a default frequency generator 490 that may be set to provide a frequency for power generation such as 50 or 60 Hertz. The default frequency generator may be implemented using a local oscillator or software executed on a processor containing a clock or any other device that allows for a periodic signal to be generated having the desired cycles per second.

[0049] In some embodiments of the present invention, the controller 440 further includes a grid period stretcher 495 which attempts to alter the frequency of the power for determining whether islanding has occurred. The grid period stretcher 495 may be implemented as a frequency drift output ~~include~~ including a programmable rate and limits which may lengthen or shorten the period of the signal provided to the power source to attempt to increase or decrease the frequency of the resultant power.

[0050] In still yet other embodiments of the present invention, the controller 440 includes a voltage range detector 497 for determining when a power source is providing power outside a selected voltage range. The voltage range detector 497 may be implemented as discrete solid state components or may be implemented using software executed on a processor or some combination thereof. The voltage range detector 497 may contain logic to evaluate whether the value of the parameter measured by the sensor 450 is within or not within a given voltage range.

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The voltage range detector 497 can reference the voltage range values which are stored in the grid sync controller. The controller may incorporate many varied components such as a mode switch logic device, a frequency range detector, frequency adjust loop, default frequency generator, a frequency range detector, a grid period stretcher, and a voltage range detector in accordance with the present invention. Alternately, these components may be distributed as discrete devices or components of other devices within the overall system 400 in accordance with the present invention. Further, these components may be implemented as discrete solid state devices or as software executed on a processor or some combination thereof. Additionally, not every component is required for every aspect of the present invention. For instance, a voltage range detector 497 is not required if frequency is the only desired parameter for consideration.

Please replace paragraph 0052 with the following amended paragraph:

[0052] Referring now to FIG. 5, a method for detecting whether a power source that was connected to the load is still providing power to a load in accordance with the present invention is illustrated. A first step is providing power having a first frequency from a first power source to the load as shown in Block 510. For instance, a utility could be providing power via the grid to a load at a frequency of 60 Hertz or within an acceptable tolerance such as plus or minus one percent. A next step is providing power having a second frequency from a second power source to the load wherein the second frequency is substantially the same as the first frequency as shown in Block 520. For instance, a generator could be providing power to the load at a frequency of 60 Hertz or within an acceptable range of the frequency of the power being supplied to the load by the grid. The next step is attempting to drift the second frequency of the power from the second power source away from the first frequency of the power from the first power source as shown in Block 530. For instance, the generator may try to alter slightly the frequency of the power it is providing to the load by raising or lowering the frequency by one percent or less. The next step is to monitor the second frequency of the power provided by the second power source as shown by

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Block 540. For instance, the frequency of the power outputted by the generator is measured. The next step is to evaluate whether the first power source is providing power to the load as shown in Block 550. In some embodiments, one or more generators serve as the second power source in providing power to the load. To evaluate whether the first power source is still providing power to the load, it is determined that the first power source is no longer providing power if the second frequency drifts away from the first frequency. Of course, it is determined that the first power source is still providing power if the second frequency does not drift away from the first frequency.